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ABSTRACT

This study provides a framework educational decision-makers can use to formulate public policies that will favorably influence the retention behavior of K-12 teachers. A teacher retention model is estimated for a sample of all teachers employed by Washington State school districts between 1984 and 1987. After an introduction, the empirical model and estimation procedures are outlined. The third section provides a description of the data and the parameter estimates. The implications of these findings are developed in section 4. Conclusions suggest that a decision to continue teaching in the same district the following year is negatively related to several school district characteristics, including assessed property value per student and the percentage of Indians and Asians in the student population, while a "stay decision" is positively correlated to district enrollment. Teacher retention is also positively correlated to district enrollment and with professional characteristics such as an elementary teaching assignment, years of teaching experience, and next year's expected salary. Appended are 10 references. (SI)

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Whether in Knowledge or in Ignorance: An Econometric Model of K-12 Public School Teacher Retention

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Abstract

This study quantifies the relationships among the personal and professional attributes of elementary and secondary (K-12) classroom teachers, the financial, institutional, and demographic characteristics of school districts, and the retention behavior of K-12 teachers employed by these districts. The goal is to provide a framework educational decision makers can use in formulating public policies which will favorably influence the retention behavior of K-12 teachers. Using probit analysis, a teacher retention model is estimated for a sample of all teachers employed by Washington State school districts between 1984 and 1987.

A decision to continue teaching in the same district the following year is negatively related to several school district characteristics including assessed property value per student and the percentage of Indians and Asians in the student population, while a "stay decision" is positively correlated to district enrollment. Teacher retention is also positively correlated with professional characteristics such as an elementary teaching assignment, years of teaching experience, and next year's expected salary. Among male teachers, retention is negatively correlated with educational attainment. Lastly, retention is a quadratic function of two variables: age and pupil-certificated staff ratios. Younger and older teachers are more likely to make a "leave decision" than are middle-aged teachers; similarly, teachers are more likely to leave districts with relatively low or extremely high staff ratios than they are to leave districts with ratios near the mean.

Introduction

Elementary and secondary education in the United States is currently under unprecedented attack on all fronts. Elected officials at all levels of government consistently lambast public schools for their failure to teach basic skills, inculcate societal values, prevent dropouts, and produce a labor force capable of maintaining U.S. competitiveness in the world marketplace. In addition, print and broadcast media provide almost daily reports upon the depths to which our educational system has plunged.

Much of the blame for the deteriorating state of American education has fallen upon the nation's K-12 public school teachers. While the validity of this conclusion is open to debate, there is little question that teacher quality has a substantial influence on student performance (Hanushek, 1986). Thus, for the foreseeable future efforts to improve primary and secondary education will hinge upon our nation's ability to attract and retain qualified individuals in teaching.

Researchers in the last 50 years have increasingly recognized the importance of this personnel question and have produced a significant body of literature dealing with the issue. Historically, though, the focus has been upon those factors which attract individuals to teaching. This is somewhat surprising since educators have long recognized that high rates of teacher turnover are disruptive to program continuity and planning, and therefore detrimental to student learning, while also burdening school districts with added recruiting and hiring costs.

The few previous studies of teacher attrition have yielded conflicting results. Greenberg and McCall (1974), in an early attempt to analyze teacher mobility, applied OLS techniques to data from Michigan and concluded that student characteristics were much more important in the decision of teachers to quit or change districts than were salary considerations. Baugh and Stone (1982), however, estimated an occupational mobility model using a multivariate logit and concluded that Oregon teachers were responsive both to interoccupational wage differences in deciding to change occupations and to wage differentials within teaching in

deciding to change districts. Murnane and Olsen (1988a & 1988b), in a pair of studies measuring the impact of salaries and opportunity costs on the career decisions of teachers in Michigan and in North Carolina, furnish compelling evidence that relative salaries do influence the length of time teachers stay in teaching.

The present study adds to our knowledge of teacher retention in two ways. First, the empirical model developed in the next section allows for a more complete characterization of the influence of non-pecuniary factors on teacher retention by including as explanatory variables several measures of each teacher's personal and professional attributes, as well as the financial, institutional, and demographic characteristics of the school districts for whom the teacher is employed. Second, the study examines the determinants of a teacher's decision to continue teaching in the same school district in which s/he is currently employed or to pursue alternative opportunities, which include transferring to a different district, leaving the public school sector, or retiring. This is the definition of attrition that is of most consequence to local district policy makers. The transfer of a teacher to another school district or state has the same impact on a school district, in terms of loss of continuity and resources, as does a career change by this individual. The focus on factors which influence retention within a district does not, of course, reflect a view that previous research into attrition from the profession is unimportant. Instead, it is motivated by a judgement that the behavior of teachers within an independent school district is important in its own right.

This study's findings are generally consistent with previous works, but deviate on several significant points. The age-attrition relationship estimated in this study agrees in part with that found by Grissmer and Kirby (1987). The earlier study concluded that women had markedly higher attrition rates early and late in their careers than men. This study concurs with the first finding, but provides evidence that older women (beyond age 45) are less likely to leave a teaching position than are older men. The work reported here also does not fully support the position that higher educational attainment is related to lower attrition (Greenberg &

McCall). While there is no statistically significant difference between the retention behavior of those female teachers with and those without graduate degrees, male teachers with graduate degrees are estimated to be about 50 per cent more likely to leave their positions than are similar male teachers without such degrees. Lastly, this study supports the significant role Baugh and Stone give to salary in influencing attrition, but only for male teachers. Female teachers in the sample were more responsive to working conditions than financial inducements in deciding to leave a position.

The next section outlines the empirical model and the estimation procedures used in this study. The third section provides a description of the data and the parameter estimates. The implications of these findings are developed in section four. The final section summarizes the major conclusions.

Empirical Framework

The process outlined here models the stay/leave behavior of K-12 public school teachers. K-12 teachers are assumed to be economically rational decision makers, who choose among alternatives so as to maximize their utility. This utility is derived from both measurable and unmeasurable factors. Examples of the former are salaries, pupil-teacher ratios, and school district expenditures. Unmeasurable factors, which from the standpoint of the observer introduce a random element into the teacher's behavior, include both the personal and professional satisfaction obtained from teaching, as well as the disutility engendered by teaching's stresses and difficulties.

Standard OLS models of the form

$$y_t = x_t\beta + e_t$$

are inappropriate for attempting to explain teacher stay/leave behavior. First, this decision involves choice between two discrete alternatives--stay or leave. Ordinary least squares models are inefficient when the dependent variable takes on qualitative values. Secondly, the disturbance term e_t is generally interpreted as being

the impact of factors known to the decision-maker but not to the observer. Another source of disturbance needs to be considered in teachers' stay/leave behavior. Teachers are a heterogeneous population and we would expect to see a distribution of responses resulting from the availability of identical alternatives to each teacher. A model of teacher retention must posit a profession in which tastes vary explicitly.

In order to deal with such issues, McFadden (1981) developed a family of qualitative response models, known as models of probabilistic choice. This study uses McFadden's hypothesis of random utility maximization to model teachers' utility functions. Random utility models begin with the classical model of rational, utility-maximizing economic actors, but include unobserved random variables which may enter teachers' utility functions. These random variables influence the utility of each individual, while introducing heterogeneity among teachers.

The model takes the form

$$y_{mt}^* = x_{mt}\beta_m + e_{mt} \quad (1)$$

$$y_{nt}^* = x_{nt}\beta_n + e_{nt} \quad (2)$$

Where: $t = 1,\ldots,T$ indexes sample observations y_{mt}^* (y_{nt}^*) is the unobserved utility from leaving (remaining in) a teaching position at time t

$x_{mt}\beta_m$ ($x_{nt}\beta_n$) is a function of attributes in the teacher's leave (stay) decision that are measurable, up to a finite vector of unknown parameters, at time t

e_{mt} (e_{nt}) is a term summarizing the contribution of the unmeasured components to the teacher's leave (stay) decision at time t

The values of y_{mt}^* and y_{nt}^* are not observable, but qualitative information is available on which is larger. If a teacher is observed leaving a position in year t ($y_t = 1$) then according to the assumptions of the model, $y_{mt}^* > y_{nt}^*$.

If the unmeasured components of the teachers' decision have a

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cumulative distribution function $F(e_t;x_t)$, then

$$\begin{aligned} & Pr\ (y_t = 1;\ x_t) \\ = & Pr\ (y_{mt}^* > y_{nt}^*) \\ = & Pr\ (x_{mt}\beta_m + e_{mt} > x_{nt}\beta_n + e_{nt}) \\ = & Pr\ (x_{mt}\beta_m - x_{nt}\beta_n > e_{nt} - e_{mt}) \\ = & Pr\ (x_t\beta > e_t) \quad (3) \end{aligned}$$

The probability of a teacher leaving will depend upon ß, the unknown parameter vector, and $F(e_t;x_t)$, the c.d.f. of the unmeasured components. The vector ß is estimated using the multivariate probit technique, which assumes that e is normally distributed. Each year, teachers compare the net measurable satisfaction received from not teaching in the district with the unobserved, unmeasured net returns from remaining in the district. These unobserved, unmeasured net returns can be thought of as the personal and professional satisfactions often attributed to a teaching position. If the measured utility from leaving is greater than this unmeasured net satisfaction, the teacher leaves the district. If the difference is less, the teacher stays.

Parameter Estimates

The empirical analysis in this section is based upon data from Certificated Personnel Reports maintained by Washington's Office of the Superintendent of Public Instruction. This annual personnel reporting system provides information on all certificated teachers employed as of October 1 by school districts in the State of Washington. This study uses data from the 1984-85, 1985-86, and 1986-87 school years. Summary statistics for classroom teachers employed by Washington school districts during this period are presented in Table 1.

The only estimated data used is the salary measure. The Certificated Personnel Report includes each teacher's actual current salary. For the purposes of this study, though, the pertinent salary variable is each teacher's expected next year's salary. Therefore, the salary figure used in this study is an estimate of the daily salary the teacher would earn the following year, if they acquired no additional education, and the state's teachers received

TABLE 1. CLASSROOM TEACHER CHARACTERISTICS

Variables		1984-85 Total	1984-85 Male	1984-85 Female	1985-86 Total	1985-86 Male	1985-86 Female	1986-87 Total	1986-87 Male	1986-87 Female
Dependent										
Stay (1 if stay, 0 if leave)	MEAN	0.918	0.927	0.912	0.919	0.930	0.911	0.924	0.934	0.918
	S.D.	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Independent										
Age	MEAN	40.0	40.8	39.5	40.4	41.2	39.9	40.8	41.6	40.2
	S.D.	9.1	8.7	9.4	9.0	8.6	9.3	9.0	8.6	9.2
Teaching experience (Years of K-12 experience)		12.5	14.3	11.3	12.8	14.7	11.5	13.0	15.1	11.7
		7.7	7.9	7.3	7.8	8.0	7.4	7.9	8.1	7.5
Salary per day		142.71	147.31	139.53	147.01	151.75	143.84	153.14	158.42	149.77
		25.44	24.18	25.80	26.39	24.52	27.10	27.35	25.11	28.17
Non-white dummy (1 if nonwhite, 0 if white)		0.055	0.046	0.060	0.055	0.046	0.060	0.056	0.047	0.061
		xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

	1984-85			1985-86			1986-87		
Variable	Total	Male	Female	Total	Male	Female	Total	Male	Female
Elementary	0.460	0.281	0.585	0.469	0.280	0.594	0.478	0.285	0.601
dummy	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
(1 if elementary 0 if secondary)									
Master's	0.289	0.352	0.245	0.291	0.354	0.249	0.293	0.356	0.253
dummy	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
(1 if received, 0 if not)									
Doctorate	0.004	0.007	0.003	0.004	0.007	0.002	0.005	0.007	0.003
dummy	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
(1 if received, 0 if not)									
Female	0.591	xxx	xxx	0.600	xxx	xxx	0.611	xxx	xxx
dummy	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
(1 if female, 0 if not)									
% Asian	4.7	xxx	xxx	4.8	xxx	xxx	5.0	xxx	xxx
students	4.6	xxx	xxx	4.8	xxx	xxx	4.9	xxx	xxx
(in school district)									

	1984-85			1985-86			1986-87		
Variable	Total	Male	Female	Total	Male	Female	Total	Male	Female
% Black	3.9	xxx	xxx	4.0	xxx	xxx	4.1	xxx	xxx
students	6.3	xxx	xxx	6.3	xxx	xxx	6.5	xxx	xxx
(in school district)									
% Hispanic	3.9	xxx	xxx	4.1	xxx	xxx	4.3	xxx	xxx
students	7.3	xxx	xxx	7.7	xxx	xxx	7.9	xxx	xxx
(in school district)									
% Indian	2.4	xxx	xxx	2.4	xxx	xxx	2.4	xxx	xxx
students	5.3	xxx	xxx	5.5	xxx	xxx	5.1	xxx	xxx
(in school district)									
Pupil-staff	19.13	xxx	xxx	19.15	xxx	xxx	18.87	xxx	xxx
ratio	1.49	xxx	xxx	1.42	xxx	xxx	1.37	xxx	xxx
(in school district)									
Unemploy.	10.2	xxx	xxx	9.2	xxx	xxx	9.2	xxx	xxx
rate	3.2	xxx	xxx	3.2	xxx	xxx	3.6	xxx	xxx
(in county)									

Variable	1984-85 Total	1984-85 Male	1984-85 Female	1985-86 Total	1985-86 Male	1985-86 Female	1986-87 Total	1986-87 Male	1986-87 Female
Expend.	2,534	xxx	xxx	2,600	xxx	xxx	2,897	xxx	xxx
per pupil	293	xxx	xxx	297	xxx	xxx	335	xxx	xxx
(In school district)									
Ass. Val.	218,928	xxx	xxx	216,557	xxx	xxx	225,372	xxx	xxx
per pupil	117,013	xxx	xxx	114,022	xxx	xxx	123,082	xxx	xxx
(In school district)									
Enrollment	10,434	xxx	xxx	10,438	xxx	xxx	10,738	xxx	xxx
(In school district)	10,161	xxx	xxx	10,048	xxx	xxx	10,165	xxx	xxx
No. observ.	37,321			37,696			38,378		

no salary increase. Teachers in Washington State were subject to statewide salary controls throughout this period, with school districts forbidden to pay average teacher salaries in excess of the average amount providing through state funding. These state funds were generated through a statewide salary allocation schedule based upon a matrix of experience/education mix factors. Since the Certificated Personnel Report also includes each teacher's current salary mix factor, each individual's expected salary for the next year is estimated by:

[Next year's mix factor assuming no further education]
divided by [This year's mix factor]
multiplied by [This year's daily salary].

The maximum-likelihood estimates of the model's empirical specification for public school teachers employed by school districts in Washington State in 1984-85, 1985-86, and 1986-87 are presented in Table 2. In addition, this information is disaggregated by sex in each of these years. The parameter estimates can be interpreted as the unnormalized change in the probability that an individual will continue teaching in the same district the following year given a unit change in the explanatory variable. The asymptotic t-statistic for each coefficient follows immediately below the estimate.

Implications

Personal and professional characteristics strongly influence the stay/leave behavior of K-12 teachers in Washington State through-out this period. Age, years of teaching experience, salary, and an elementary teaching assignment are all statistically significant at the 95 per cent level in each year. Two district variables, pupil-staff ratio and assessed valuation per pupil, are also significantly related to retention behavior in each year.

When these data sets are disaggregated by sex, only age is statistically significant for both sexes in all years. Three other professional characteristics are significantly related to stay/leave

TABLE 2. PARAMETER ESTIMATES FROM PROBIT MODEL OF STAY/LEAVE DECISIONS

	1984-85			1985-86			1986-87		
Variables	Total	Male	Female	Total	Male	Female	Total	Male	Female
Intercept	-6.24	-4.55	-6.20	-5.23	-5.01	-5.14	-4.87	-5.82	-3.59
(t)	(-7.90)	(-3.82)	(-6.16)	(-6.72)	(-3.94)	(-5.41)	(-5.75)	(4.34)	(-3.43)
Age	23.95	19.60	19.45	20.92	16.95	20.62	22.24	19.50	18.98
	(17.94)	(12.54)	(18.78)	(15.18)	(10.10)	(20.11)	(16.31)	(12.09)	(18.35)
Age^2	-30.10	-25.93	-23.21	-26.94	-22.48	-24.94	-28.23	-25.38	-22.89
	(-19.81)	(-14.89)	(-19.39)	(-17.32)	(-12.07)	(-20.97)	(-18.54)	(-14.43)	(-19.04)
Teaching experience	0.87	1.26	0.57	1.07	1.08	1.06	0.96	0.66	1.09
	(3.86)	(3.44)	(1.98)	(4.88)	(2.80)	(3.88)	(4.34)	(1.73)	(3.94)
Salary per day	3.61	6.46	2.60	2.14	4.39	1.40	1.57	3.70	0.79
	(6.36)	(6.09)	(3.81)	(4.28)	(4.00)	(2.43)	(3.10)	(3.87)	(1.30)
Non-white dummy	0.01	-0.04	0.04	0.06	-0.01	0.10	0.04	-0.05	0.08
	(0.14)	(-0.55)	(0.69)	(1.42)	(-0.15)	(1.84)	(0.90)	(-0.60)	(1.57)
Female dummy	0.90	xxx	xxx	-0.08	xxx	xxx	0.49	xxx	xxx
	(2.94)	xxx	xxx	(-0.24)	xxx	xxx	(1.54)	xxx	xxx
Age * female dummy	-5.96	xxx	xxx	-1.56	xxx	xxx	-4.14	xxx	xxx
	(-3.98)	xxx	xxx	(-1.02)	xxx	xxx	(-2.71)	xxx	xxx

	1984-85			1985-86			1986-87		
Variables	Total	Male	Female	Total	Male	Female	Total	Male	Female
Age^2 * female dummy	8.23 (4.74)	xxx xxx	xxx xxx	3.51 (1.99)	xxx xxx	xxx xxx	6.28 (3.59)	xxx xxx	xxx xxx
Elementary dummy	0.12 (5.78)	0.06 (1.72)	0.15 (5.75)	0.14 (6.60)	0.09 (2.54)	0.15 (6.21)	0.10 (4.89)	0.03 (0.70)	0.13 (5.22)
Master's dummy	0.49 (1.16)	-0.81 (-1.11)	1.28 (2.50)	-0.98 (-2.30)	-1.98 (-2.66)	-0.35 (-0.66)	1.04 (-2.49)	-2.28 (-3.06)	-0.41 (-0.81)
Doctorate dummy	0.07 (0.16)	-0.97 (-1.26)	0.56 (1.02)	-1.41 (-3.13)	-2.14 (-2.75)	-1.13 (-2.01)	-1.34 (-3.05)	-2.65 (-3.44)	-0.66 (-1.20)
Age * grad dummy	-3.76 (-1.92)	2.10 (0.62)	-7.44 (-3.08)	2.67 (1.35)	8.01 (2.34)	-0.76 (-0.31)	3.03 (1.58)	8.68 (2.54)	0.18 (0.08)
Age^2 * grad dummy	5.02 (2.28)	-1.31 (-0.34)	9.00 (3.29)	-1.52 (-0.68)	-8.24 (-2.17)	2.92 (1.05)	2.07 (-0.96)	-8.10 (-2.15)	0.96 (0.36)
% Asian students	-1.55 (-2.70)	-1.21 (-1.28)	-1.77 (-2.44)	0.38 (0.67)	-0.60 (-0.66)	1.00 (1.41)	1.19 (-2.30)	-2.23 (-2.60)	-0.54 (-0.82)
% Black students	0.49 (1.15)	0.41 (0.59)	0.55 (1.02)	-0.69 (-1.67)	0.28 (0.41)	-1.29 (-2.46)	0.07 (0.19)	1.09 (1.81)	-0.51 (-1.14)

	1984-85			1985-86			1986-87		
Variables	Total	Male	Female	Total	Male	Female	Total	Male	Female
% Hispanic students	0.24 (1.68)	0.49 (2.03)	0.10 (0.56)	0.21 (1.55)	0.26 (1.16)	0.17 (1.02)	0.05 (-0.41)	0.23 (0.98)	-0.24 (-1.45)
% Indian students	-0.59 (-3.86)	-0.51 (-2.16)	-0.59 (-2.91)	-0.38 (-2.31)	-0.04 (-0.15)	-0.59 (-2.86)	0.46 (-2.63)	-0.26 (-1.00)	-0.58 (-2.46)
Pupil-staff ratio	19.04 (2.93)	9.13 (0.91)	25.24 (2.94)	21.11 (3.27)	20.58 (1.86)	20.17 (2.50)	18.97 (2.74)	27.25 (2.42)	13.07 (1.47)
Pupil-staff ratio^2	-36.93 (-2.31)	-9.33 (-0.35)	-54.48 (-2.38)	-47.99 (-2.79)	-37.98 (-1.27)	-50.97 (-2.38)	46.35 (-2.49)	-60.53 (-1.99)	-35.85 (-1.51)
Unemploy. rate	-0.92 (-2.42)	-1.15 (-1.79)	-0.77 (-1.63)	-0.61 (-1.69)	-1.39 (-2.42)	-0.05 (-0.11)	0.15 (-0.43)	-1.17 (-2.09)	0.56 (1.21)
Expend. per pupil	2.13 (3.07)	1.49 (1.34)	2.47 (2.76)	1.21 (1.92)	1.87 (1.80)	0.73 (0.92)	0.25 (0.41)	1.49 (1.48)	-0.57 (-0.72)
Ass. Val. per pupil	-0.42 (-3.75)	-0.60 (-3.50)	-0.28 (-1.90)	-0.50 (-4.27)	-0.55 (-2.91)	-0.45 (-3.01)	0.31 (-2.91)	-0.29 (-1.61)	-0.33 (-2.45)
Enrollment	0.45 (2.27)	0.30 (0.93)	0.50 (1.97)	0.37 (1.86)	-0.22 (-0.67)	0.71 (2.85)	0.64 (3.51)	0.34 (1.07)	0.79 (3.55)

behavior in all years for one sex. Years of teaching experience and an elementary teaching assignment are both positively correlated with a "stay" decision among female teachers. Salary is positively correlation with a "stay" decision among male teachers.

Retention behavior is a quadratic function of age in all specifications, supporting earlier findings by Grissmer and Kirby. In 1986-87, when other factors are evaluated at their sample means, each birthday for teachers 44 or younger increased the probability they would return to teaching in the same district in 1987-88, while this probability declined with each birthday after 45.

Significant differences exist, though, between male and female teachers in this regard. While the age-retention curve for both groups follow a quadratic path, female teachers in their 20's and 30's are significantly less likely to remain in teaching than are males of the same age, while older female teachers are significantly more likely to remain in teaching than older males each year. This finding contradicts Grissmer and Kirby's previous suggestion that older female teachers are less likely to remain in teaching than their male counterparts.

The influence of salary on a teacher's retention decision is one of the most debated points in educational policy analysis. When all other factors are held constant, a teacher's next year's salary is positively correlated with a "stay decision", at a 99 per cent significance level, for all teachers and for male teachers in each year. The statistical power of the relationship is not as overwhelming for female teachers, but remains significant at the 95 per cent level in two of the three years. In 1986-87, a teacher with prospective earnings ten per cent above the mean, with all other factors evaluated at their sample means, was 6.9 per cent less likely to leave a teaching position.

Contrary to the findings of Mueller (1976) which suggest that minority teachers have lower rates of turnover, a teacher's race was not correlated at the 95 per cent significance level with stay/leave behavior in any of the nine specifications. For the subset of female teachers, being non-white is positively correlated at the 85 and 90 per cent levels in 1985-86 and 1986-87, respectively.

However, the stay/leave behavior of non-white male teachers is indistinguishable from white male teachers.

A finding with important policy implications, given the current national trend towards higher teacher certification standards, is that for the last two years there existed a strong positive correlation between educational attainment and leaving a teaching position. Oaklander (1969) and Pedersen (1973) found similar relationships for veteran teachers, as well as those who were married or worked at the secondary level. In 1985-86, teachers possessing master's degrees are estimated to have been 33.6 per cent more likely to leave their positions than were comparable teachers without master's degrees. In the same year, the few teachers holding doctorates are estimated to have been 42.1 per cent more likely to leave than were comparable teachers without doctorate degrees. In 1986-87, the estimates are a 35.1 per cent higher probability of leaving for master's degree holders and a 41.0 per cent greater probability for those with doctorates.

This phenomenon has been driven almost entirely by the behavior of male teachers. Male teachers with graduate degrees are estimated to be at least 47.6 per cent more likely to leave their positions in each of the last two years than similar male teachers without such degrees. There is no statistically significant difference between the retention behavior of those female teachers with and those without graduate degrees. These results suggest that as policy makers move to increase the educational levels required of teachers in their state (e.g. beginning in 1992, all Washington teachers will be required to earn a master's degree in order to receive standard certification), they must also improve the perceived relative benefits of teaching or the state could face sharply higher attrition by male teachers.

The strongest relationship between a school district characteristic and the stay/leave behavior of its teachers is in terms of assessed valuation. Contrary to common wisdom and previous research (Greenberg & McCall), teachers in "wealthy", high assessed valuation districts are more likely to leave their jobs than comparable teachers elsewhere, when other factors are held constant.

In each of the three years, a strong (99 per cent confidence level) positive correlation exists between assessed valuation per pupil and the likelihood the district's teachers will leave the following year. In 1986-87, with all other factors held constant, a teacher in a district with assessed valuation ten per cent above the state's mean ($247,909/pupil as opposed to $225,372/pupil) is estimated to have been 2.1 per cent more likely to leave than a teacher in a school district with assessed valuation at the state's mean.

One possible explanation for this finding is that assessed valuation per pupil measures a degree of urbanization not defined elsewhere in the model. According to this argument, school districts with high assessed valuations are predominately urban districts which offer teaching positions that entail low non-pecuniary benefits. The sum of these benefits and the nearly constant salary provided by the state creates a situation in which teachers receive less utility from positions in wealthy districts and therefore leave such jobs in greater numbers.

Numerous other possible explanations exist as well. One possibility is an extension of the sociological principle of relative deprivation. As an example of how this principle might apply, consider the relative situation of two 30-year-old teachers, both earning $25,000, one of whom is employed in an economically-depressed rural area, while the other works in an upper-middle-class suburban district. The social and financial position of the former teacher, relative to people in the town working in other occupations is quite high. The latter teacher, earning the same salary, is not doing as well, either in terms of status or in terms of relative wealth and may therefore be more likely to leave teaching.

An aspect of retention behavior which falls outside the range of this study, but which almost certainly influences this process is the relative recruiting strategies of high and low assessed valuation districts. It seems likely that wealthier districts are more aggressive in their recruiting efforts than are poorer districts. If these efforts are successful, and the district attracts individuals it would not otherwise have employed, the district may be hiring teachers who are less committed to that

particular community than might be the case if the district depended more heavily upon self-selection. These less committed teachers may be more likely to leave the district. A fourth possibility is that wealthier districts may also perceive that they are in a relatively stronger recruiting position than poorer districts and therefore may be more willing to encourage turnover among marginal teachers.

Another finding with important policy implications relates teacher retention to teacher-pupil ratio. The stay/leave behavior of K-12 teachers in Washington is a quadratic function of class size in all three years. As expected, extremely large pupil-staff ratios are detrimental to staff retention. However, according to the parameter estimates outlined in Table 2, efforts to significantly lower a district's pupil-staff ratios may be counterproductive in terms of teacher retention. While this model provides few clues as to the cause of this anomaly, it is obvious that money spent to lower class size is not available for other purposes. Possibly, school districts with larger pupil-teacher ratios use the savings realized from these low employment levels to support programs which benefit their smaller staffs to a greater degree than is possible by simply increasing the number of employees. These results suggest that the current push in many states to focus district resources on class size reduction may have unanticipated consequences.

Summary

This study focuses upon identifying the personal, professional, and institutional factors which are correlated with K-12 teacher retention. Several personal characteristics are found to strongly influence teacher retention, including age, experience, next year's salary, and sex. The influence of professional characteristics on teacher retention centers on the teacher's grade level assignment and educational attainment. School district characteristics instrumental in determining teacher retention are assessed valuation per pupil, pupil-certificated staff ratio, district enrollment, and the percentage of the student population who are Indian or Asian.

The sign of each of these coefficients is as expected, with the exception of assessed valuation per pupil and educational

attainment. In each year, the likelihood that a teacher will remain in the same position the following year is negatively correlated with the assessed valuation of the school district for which s/he is employed. Wealthier districts have been generally assumed to provide greater non-pecuniary benefits than property-poor districts (Greenberg & McCall); these results suggest that higher assessed valuation districts may provide lower non-pecuniary benefits perhaps because of greater urbanization, lower status and wealth relative to others in the community, and a poorer match between the district and the teacher due to more aggressive recruiting. In addition, while there is no statistically significant difference between the retention behavior of those female teachers with and those without graduate degrees, male teachers with graduate degrees are estimated to be about 50 per cent more likely to leave their positions than are similar male teachers without such degrees.

Age is the only explanatory variable which is statistically significant for both sexes in all years. The age-attrition relationship estimated in this study provides evidence that contrary to previous findings (Grissmer & Kirby) older women (beyond age 45) are less likely to leave a teaching position than are older men. Three other personal characteristics are significantly related to stay/leave behavior in all years for one sex. Years of teaching experience and an elementary teaching assignment are both positively correlated with a "stay" decision among female teachers. Salary is positively correlated with a "stay" decision among male teachers. This provides evidence that Baugh and Stone's finding of a strong positive correlation between salary and a "stay" decision may apply to male teachers only.

Two other explanatory variables are correlated with the retention decisions of female teachers in each year. The percentage of Indian students in the school district is negatively related to a "stay" decision, while school district enrollment is positively correlated with a "stay decision" each year. The latter result differs from the conclusion of Mueller whereby district size was positively related to attrition.

These results suggest that male teachers appear to respond more strongly to financial inducements, while female teachers are more influenced by the non-pecuniary aspects of teaching. Retention decisions by male teachers are negatively correlated with educational attainment and positively correlated with salary, while "stay" decisions by females are related to non-financial variables such as years of teaching experience, elementary versus secondary teaching assignment, percentage of Indian students, and school district size.

The goal of this paper has been to provide a framework decision makers can use in order to formulate public policies which will favorably influence the retention behavior of K-12 teachers. In order to succeed in their task, policy makers must recognize that a school district's ability to recruit and retain qualified teachers is tied inexorably to the perceived relative benefits of teaching in the district. Results presented in this paper provide guidance as to the effectiveness of several current policy options in increasing these relative benefits.

First, the results suggest that calls by school finance reformers to narrow salary differentials across district lines may lead to increased turnover in high assessed valuation districts, especially on the part of male teachers. Second, these data caution that moves by states to mandate higher educational attainment by teachers must be accompanied by improvements in salary if these mandates are not to lead to significantly higher attrition by male teachers. Finally, they contradict claims which attempt to link lowered pupil-teacher ratios to lower teacher turnover.

The current research focus on teacher recruitment is only a first step in rebuilding and renewing our schools; once these teachers are in the classroom, it is imperative that our schools have the knowledge base needed to assist in retaining the services of these individuals. In order to provide such a knowledge base, additional research is needed to help policy makers more efficiently and effectively shape teacher personnel policies.

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